Flora W. Patterson

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CROWN GALL.

— BY —

WENDELL PADDOCK.

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PLATE I.

THE COLORADO EXPERIMENT STATION.

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CROWN GALL.

By Wendell Paddock.

The subject of crown gall is one of vital importance in Colorado, since under our conditions the organism that is responsible for this disease of fruit trees and plants, finds congenial surroundings for growth and distribution.

The so-called galls are irregular outgrowths of tissue that commonly form around the crown of a tree just below the surface of the ground. They also occur frequently on the roots, but are quite different in appearance from the swellings that are produced by the attacks of woolly aphis, which unfortunately are also very destructive in our State.

The galls increase rapidly in size, when the conditions are favorable, and so interfere with the process of nutrition that the vigor of the tree is greatly impaired. In many instances the death of the tree is but a matter of a few years. The point of attack being underground, the infected trees are commonly unnoticed until they begin to fail. This stage may be recognized by the weak growth and yellow appearance of the foliage.

The pictures in this bulletin give a good idea of the appearance of crown gall. Plate I. shows an extreme case of the disease as affecting a six-year-old plum tree. This tree was undoubtedly attacked in the nursery, and the continued growth of the gall so interfered with its nutrition that it was able to make but a feeble growth and was nearly dead when it was dug. Plate II. is from a photograph of a peach tree, showing a large gall on the roots and a somewhat unusual case of the development of galls on the trunk above ground. Plate III. shows badly diseased apple trees just as they were received from the nursery.

This disease first began to attract the serious attention of Experiment Station workers in 1892, when the California station published a bulletin on the subject. This was followed by a number of articles from different Experiment Stations, but it was not until 1900 that any definite knowledge of the disease was gained. During this year Prof. Toumey, of the Arizona Experiment Station, published a bulletin, in which he proved that crown galls on almond, apricot and peach trees are produced by the irri-

tation of a slime mould, one of the lower forms of fungi. He was able to produce galls at will on young seedlings by inoculating them with bits of the galls, also by planting seedlings in sterile soil and then placing pieces of minced galls about their roots. Under certain conditions minute reproductive bodies are formed on the surface of the galls, which easily work their way through damp soil, or may be carried by irrigation water from tree to tree. Particles of the galls may also be carried by cultivators and other tools, so that it is easy to conceive how the disease may spread from a single infected tree to all the trees in an orchard.

Indications also point to the conclusion that the organism may remain alive for some time in decayed galls, or in galls on dead trees, or on diseased trees that have been removed from the orchard.

It is difficult to estimate the amount of damage that crown gall is responsible for, as it is a disease that is commonly overlooked, and then it is usually several years after infection that the apparent vigor of the tree is affected. Reports from a number of the County Horticultural Inspectors, as well as personal observations, show that crown gall is a common disease in Colorado. It is evident, also, from what has been said, that the effects of the disease will become more apparent as the orchards grow older.

Prof. Tourney has the following to say about the amount of damage that can be attributed to the disease:

> The seriousness of crown gall in various and widely separated portions of the country, is certainly indicative of an enormous annual loss to the fruit industry. In estimating the amount of damage done by crown gall, consideration must be given to the fact that it usually occurs underground, and is rarely seen except when the trees are taken from the nursery, or when excavations are made at the crowns. The majority of diseased trees live on year after year, but make less growth and in all probability produce less and poorer fruit than healthy trees. It is not sufficient for a tree to simply live. It must grow and fruit abundantly to be profitable. The total annual loss from this disease in this country in all probability reaches the enormous sum of from $500,000 to $1,000,000, possibly much more.

Crown gall is found on a variety of plants, including almond, apple, apricot, blackberry, cherry, chestnut, English walnut, grape, peach, pear, plum, poplar and raspberry. In the experiments above mentioned, it was found that the disease could be transferred readily from the almond to apricot and peach trees, thus indicating that the same organism is responsible for crown gall on these three hosts. Serious investigation of the galls on the other trees and plants have not yet been undertaken, but it is likely that the disease is of the same nature, if not induced by the same organism. It is to be hoped that this point may soon be established, as it is important to know, for instance, whether diseased raspberry and blackberry bushes, when planted in an orchard, may not be the means of infecting the trees, or, in the

case of a mixed orchard, the disease may not spread from stone fruits to apples and pears, or *vice versa*.

The disease does not seem to be so destructive in most sections where irrigation is not practiced, consequently many nurserymen give it no attention, or are entirely ignorant of the subject. That crown gall is abundant in such nursery districts is proven by the fact that but few shipments of nursery stock are ever received from points outside of the State that are entirely free from the disease. One County Horticultural Inspector destroyed two car-loads of trees in one season, largely because they were infected with crown gall. Most of our inspectors are equally rigid in their examinations, but it is impossible to detect all diseased trees, especially where the disease has just started.

Prof. Toumey goes so far as to say :

> Every tree that comes from an infested nursery is dangerous, and when such trees are planted, great chances are taken.

And again :

> If bundles of trees are received having a few with galls upon them, it is not safe to simply throw out the visibly diseased ones. There is no reason why the remainder of the bundle should not have the infection upon them from contact with diseased trees, and the whole should be destroyed.

The following extract from Bulletin No. 191 of the State Experiment Station of New York, may be taken as representing the general attitude of nurserymen toward the disease :

> We find crown gall not uncommon in the nurseries in western New York, but we know of no case where it has caused material loss. * * * Usually nurserymen discard the worst affected trees.

So long as the disease is not serious in their own locality, the nurserymen see no reason why they should go to the expense and trouble necessary to eradicate it, consequently the disease has spread, gradually, until it is quite common in many of the nursery districts.

The Experiment Station occasionally receives letters from nurserymen protesting against the destruction of their stock. One firm thought that fraud was being practiced when their trees were rejected, as they had never heard of this disease. Another nurseryman sent 100 high priced trees to the Experiment Station which were all condemned by the Inspector. This gentleman claimed that the galls, many of which were as large as one's fist (Plate III.), were due to a characteristic varietal growth, and not to a disease.

The best remedy for most plant diseases is preventative rather than curative, therefore the best line of treatment for crown gall would be, first of all, to buy nursery stock from nurseries that are known to be free from the disease. And in this connection it is a pleasure to state that, so far as is now known, all the nurseries of this State are free from crown gall.

PLATE II.

It will not do to try to remove the galls before the tree is planted, as it is likely that with the greatest care some of the organism will remain. In that case the disease has been introduced into the orchard, and the infection of the healthy trees is only a question of time. The majority of trees that are infected in the nursery, when planted in Colorado, make an unsatisfactory growth, and probably but few of them ever live to produce paying crops.

The disease does not appear to be so destructive to older trees, but nevertheless its effects are severe. Some experiments conducted in Arizona indicate that in such cases the disease may be held in check in a measure. The mode of treatment consists in examining the trees every season and cutting away all traces of galls from about the crowns. The wounds are then thoroughly covered with a paste made after the following formula:

Copper sulphate (bluestone), two parts.
Iron sulphate (copperas), one part.
Lime (unslaked), three parts.

The three ingredients are reduced to a fine powder then mixed thoroughly, after which enough water is added to make a thick paste.

All diseased wood should be collected and burned.

The important point, then, in controlling crown gall would seem to be to keep the disease out of the orchards, and in order to do this it is necessary to secure nursery stock that is free from the infection. All possible assistance should be given the County Inspectors in their inspection of nursery stock. In counties where many trees are being planted, sufficient assistance should be provided, so that there will be no possibility of any shipments being overlooked. And, finally, some means should be devised whereby the importance of inspection can be impressed on the growers, since, in some instances, they antagonize the inspectors and hinder their work. It is no doubt true, that the inspection of nursery stock alone, if well done, pays many times over for all the expense incurred, even in those counties which expend the most money in orchard inspection.

PLATE III.